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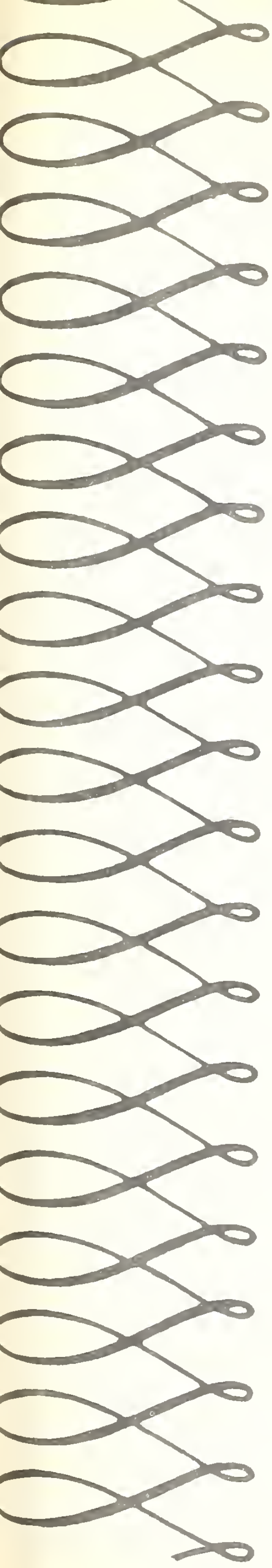

EFFECTS OF COTTON GINNING PRACTICES ON MARKET QUALITY OF COTTON

A Mississippi Delta Variety, 1958-59

U.S. DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service · Economic Research Service
Agricultural Research Service

PREFACE

This study of cotton ginning and harvesting practices is part of a broad program of research by the Agricultural Marketing Service to improve product quality and increase efficiency in marketing agricultural products. It is related to a series of investigations on the effects of various cotton ginning and harvesting practices on the grade and staple length, fiber quality, processing performance, and quality of products manufactured from raw cotton. This research, aimed at preserving the inherent quality of cotton along with the use of efficient and economical practices, is conducted by the Market Quality Research Division of the Agricultural Marketing Service in cooperation with the Economic Research Service and the Agricultural Research Service, various State Experiment Stations, and private industry groups.

This report deals with the fiber properties and spinning performance of a widely grown variety of Mississippi Delta cotton as affected by certain practices in drying, cleaning, and conditioning seed-cotton and lint at the gin for mechanically-harvested and hand-picked lots. It analyzes effects of these practices on lint quality, as it relates to cotton bale market values and mill processing costs.

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Washington, D. C. January 1963

SUMMARY AND CONCLUSIONS

The study involved 42 bales of cotton ginned from three consecutive harvestings of DPL-15 cotton at Robinsonville, Mississippi, of which 36 bales were mechanically harvested, and 6 bales were picked by hand. Ginning conditions included: elaborate and moderate seed-cotton cleaning; drying to provide both high- and low-moisture lint with each seed-cotton cleaning treatment; and three conditions of lint cleaning for each level of moisture: No lint cleaning, one lint cleaner, and two lint cleaners. The mechanically harvested cotton provided 3 replications for each of 12 ginning conditions. The handpicked cotton provided three replications each for the two extreme ginning conditions that were used with mechanically-harvested cotton.

Cotton from the first harvest contained less moisture than the second and third lots of seed cotton, and, consequently, needed less heat in drying during ginning. Drying conditions were varied to provide high- and low-moisture lint during ginning. The high-moisture lint averaged 6.1 percent, and the low-moisture lint averaged 2.6 percent.

Grade for both machine- and hand-picked cotton was improved by additional lint cleaning.

The staple length of machine-picked cotton ranged from 1 1/16 to 1 3/32 inches for high-moisture lint and from 1 1/32 to 1 1/16 inches for low-moisture lint.

Total Shirley Analyzer waste was significantly less in low-moisture lint lots than in those ginned with high moisture. It also decreased significantly for each lint cleaner that the cotton passed through. However, there were no significant trends for total foreign matter in card sliver.

Array tests on ginned lint and card sliver indicated that high-moisture lint had a significantly greater mean fiber length and a lower coefficient of length variation, than both ginned lint and card sliver from low-moisture lint. Low-moisture lint produced a significant increase of short fiber in the card sliver. Additional lint cleaning caused a significant decrease in array mean fiber length and an increase in short fiber content. The average upper quartile length of the card sliver was 0.04 inch shorter than that for the ginned lint. Fibrograph tests showed the same trend as the array tests, but differences were smaller.

Fiber strength by "0" gauge Pressley test indicated no significant effects of ginning conditions on fiber strength, but there were some significant effects of moisture content and lint cleaning on the fiber strength in card sliver. Fiber strength by the 1/8-inch gauge Pressley test indicated no significant effects of ginning conditions on the fiber strength of the ginned lint or the card sliver. Card sliver fibers were stronger than those of ginned lint from the same tests lots, both by "0" and 1/8-inch gauge Pressley tests.

Picker and card wastes were directly affected by ginning conditions. More processing waste was found in the high-moisture lint, indicating less effective cleaning at the gin. The use of lint cleaners caused a progressive decrease in picker and card waste. Ginning conditions did not significantly affect neps in card web; however, the use of two lint cleaners tended toward an increase of neps.

The poorest spinning performance as determined by ends-down per 1,000 spindle hours for 40's yarn was obtained from bales of high-moisture lint ginned with elaborate seed-cotton cleaning. The spinning performance of 30's yarn followed the same trend as that of 40's yarn.

Yarn appearance index for 40's yarn was reduced significantly by lint cleaners. The highest yarn grade was obtained from high-moisture lint ginned with moderate seed-cotton cleaning and no lint cleaning.

Hand-picked cotton had fewer neps in the card web, and fewer ends-down for both 30's and 40's yarn than the machine-picked cotton.

Results of this study thus confirm findings of previous studies of the effects of cotton-ginning practices on fiber properties and yarn quality. However, the spinning end-breakage of yarn showed a reversal of trend in spinning performance with drying practices.

Because of reductions of up to 35 pounds in bale weight by removal of moisture and foreign matter, drying and cleaning were not so profitable to the grower as the price per pound of ginned lint would indicate. At 1958 and 1960 prices, the use of two lint cleaners usually resulted in some net gain in bale value, but drying to low moisture resulted in a net loss; that is, the reduction in bale value due to weight loss was greater than the increase in price per pound due to grade improvement.

Cotton that had the most fiber damage usually brought the highest price per pound, because grade improvement due to drying and lint cleaning more than offset reductions in staple length.

Manufacturing waste was less in the high grades, so that differences in mills' clean cotton costs were slightly less than differences in raw cotton prices. However, prices for the different qualities fell practically in the same order, whether ranked by raw cotton prices or clean cotton costs, and in either 1958 or 1960.

There was no significant correlation between break factor and either raw cotton price or clean cotton cost, but when the white grades and the light spotted grades are considered as separate groups, the highest priced lots in either group generally produced the weakest yarn and the poorest yarn appearance. One lot graded Strict Low Middling plus had a break factor of 1772 and was priced at 30.78 cents in 1958. Another lot, graded Low Middling, had a break factor of 2148 and was priced at 24.93. Twenty-one percent stronger yarn was made from the cotton that was priced 5.85 cents lower.

Better yarn appearance, also, was usually associated with lower grades and lower prices, and poorer yarn appearance with higher grades and higher prices.

There was no significant correlation of ends-down in spinning 40's yarn with either grade or price. Even though cottons ginned at a low-moisture level were inferior in length and length distribution, this was not consistently reflected in spinning, probably because of the relatively low level of ends-down obtained by using pilot-plant procedures.

EFFECTS OF COTTON GINNING PRACTICES ON MARKET QUALITY OF COTTON A MISSISSIPPI DELTA VARIETY, 1958-59

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BACKGROUND

During recent years those segments of the cotton industry engaged in cotton production, processing, and manufacturing, have made extensive changes in methods and operating practices in order to reduce operating costs and increase efficiency. Approximately one-half the cotton crop is now harvested mechanically, and cultivation practices have been adapted to facilitate harvesting of cotton in volume by machines. Extensive changes have been made in gins to handle this machine-harvested cotton. Cotton mills have increased production rates and have made adjustments in their processing organization for maximum utilization of cotton harvested and ginned by present-day practices.

All these technological developments place greater importance on the inherent properties of the cotton fiber. Increased evidence that mechanization is having detrimental effects on the manufacturing performance of cotton stimulated the undertaking of fact-finding tests to uncover factors that cause these effects. The tests reported here studied the effects of some harvesting and ginning practices on the quality of cotton as measured by fiber properties, spinnability, and product quality.

Two previous studies have been made of the effects of the various ginning practices on fiber properties and processing performance. The first study 2/ was made on 1957 crop cotton from the Tulare, Calif., area and was ginned under 12 controlled conditions. The processing phase of this study was performed by a mill under the supervision of personnel from the U. S. Department of Agriculture. The second study 3/ was made on cotton from the San Joaquin Valley of California, which was the first cotton to be processed at the U. S. Department of Agriculture Cotton Quality Research Laboratory, AMS, Market Quality Research Division, Clemson, S. C.

1/ Mr. Shanklin is a cotton technologist in the Agricultural Marketing Service; Mr. Calkins is a marketing specialist in the Economic Research Service; and Mr. McCaskill is an agricultural engineer in the Agricultural Research Service.

2/ Anonymous. Effects of Cleaning Practices at Gins on Fiber Properties and Mill Performance of Cotton. A Progress Report. U. S. Dept. Agr. Mktg. Res. Rpt. No. 269, 19 pp. Aug. 1958.

3/ Ross, John E., Leonard, Clarence G., and Shanklin, Edward H. Fiber and Spinning Properties as Affected by Certain Ginning Practices, San Joaquin Valley, California, Season 1958-59, Preliminary Report, 40 pp. 1960.

This study is a segment of the investigation dealing with the fiber properties and spinning performance of cotton as affected by certain ginning practices of drying, cleaning, and conditioning seed cotton and lint, and compares the quality of mechanically-harvested and hand-picked lots of cottons of a variety grown in the Mississippi Delta, season 1958-59.

METHOD OF STUDY

Forty-two bales of 1958 DPL-15 cotton, grown at Robinsonville, Miss., were tested; 36 were machine-picked, and 6 were handpicked. The 42 bales came from 2 separate fields, on 1 plantation, that had received similar applications of insecticides and defoliants before harvesting. The defoliants were applied at different dates for each field. The cotton was harvested by three pickings on different dates. The 14 bales from each picking were distributed at random over the 12 ginning treatments of the machine-picked cotton, and 2 ginning treatments of the handpicked cotton.

The 12 ginning organizations consisted of 2 levels of seed-cotton cleaning, 2 levels of drying, and 3 levels of lint cleaning. Three bales of machine-picked cotton were ginned under each combination of seed-cotton cleaning, drying, and lint cleaning to obtain the three replications. Three bales of handpicked cotton (one from each harvesting) were ginned under conditions corresponding to the maximum and the minimum ginning treatments for machine-picked cotton (table 1).

Samples for fiber, moisture, Shirley Analyzer, and fractionation tests were secured at the time of ginning. The moisture tests (oven method), Shirley Analyzer tests, and fractionation tests were performed by the Agricultural Research Service's Cotton Ginning Research Laboratory, Stoneville, Miss. The remaining tests were completed by the Agricultural Marketing Service's Cotton Pilot Spinning Laboratory, Clemson, S. C.

All fiber and spinning tests were performed according to a standard organization. The Suter-Webb array, Fibrograph, "0" and 1/8-inch gauge Pressley strength, Micronaire, and Causticaire tests were made on each of four samples taken at intervals from each bale at the gin lint slide. Tests of the same fiber properties were made on one sample of card sliver produced from each bale.

The bales were delivered to the opening room, and the ties removed 24 hours before being processed through the picker. This allowed the cotton to "bloom" and condition. Samples for determining the moisture content of each bale were taken at the one-fourth, one-half, and three-fourths levels of the bale before starting the opening and picking operation.

Each bale was fed through an opening and picking line consisting of two blender feeders, a lattice opener, a hopper feeder, and a one-process picker. The one-process picker consisted of two sections: The first equipped with a blade beater, and the second with a Kirschner beater. The blade beater delivered 60 blows per inch and the Kirschner beater delivered 43 blows per inch.

Table 1.--Ginning organization for spinning test for 36 bales of machine-picked and 6 bales of hand-picked Mississippi Delta cotton, season 1958-59

Lint moisture-level and cleaning treatment	Elaborate seed-cotton cleaning and drying equipment 1/ Gin stand equipment 2/				Moderate seed-cotton cleaning and drying equipment 3/ Gin stand equipment 2/			
	Seed-cotton drying temperature (°F.)				Seed-cotton drying temperature (°F.)			
	Dryer intake: 4/		Dryer outlet: 4/		Dryer intake: 4/		Dryer outlet: 4/	
	1st dryer	2nd dryer	1st dryer	2nd dryer	1st dryer	2nd dryer	1st dryer	2nd dryer
Machine-picked lots:								
High-moisture lint:								
No lint cleaners	233	88	139	87	226	85	151	92
1 lint cleaner 5/	183	89	128	88	259	88	147	93
2 lint cleaners 6/	192	88	126	86	191	86	132	89
Low-moisture lint:								
No lint cleaners	444	434	252	245	426	424	244	247
1 lint cleaner 5/	427	413	247	247	439	436	248	254
2 lint cleaners 6/	411	400	242	240	430	426	238	241
Handpicked lots:								
High-moisture lint:								
No lint cleaners					179	86	122	86
Low-moisture lint:								
2 lint cleaners 6/	369	336	202	188				

1/ 1 24-shelf tower dryer, 1 7-cylinder cleaner, 1 master overhead bur extractor, 1 24-shelf tower dryer, 1 72-inch cleaner.

2/ 4 master extractor cleaner feeders, 4 90-saw gin stands.

3/ 1 24-shelf tower dryer, 1 24-shelf tower dryer, 1 7-cylinder cleaner, 1 72-inch cleaner.

4/ Average of 3 readings during ginning for first dryer and for second dryer.

5/ Unit saw-type cleaner.

6/ Battery-type cleaner.

This opening and picking line was set up to produce a 14-ounce picker lap. The picker laps were moved to the card room and conditioned for a minimum of 12 hours before being carded.

All cotton was processed through the carding operation on an individual bale basis. The processing of that portion of card sliver used to produce one doff of 40's filling yarn was continued on an individual bale basis. The remaining card sliver from the three bales which had received the same ginning treatment was blended at the drawing process to form a composite to be used in manufacturing 30's warp yarn.

The carding operation was set up to produce a 50-grain sliver at a production rate of 9 1/2 pounds per hour. During the carding of each lap, a separate nep count was made by two technicians. Three nep boards were taken at four equal intervals during the carding of the lap, the first being taken when the lap was one-fourth processed.

Two processes of drawing were used, feeding eight ends, with an operating speed of 265 feet per minute. The first process produced a 53-grain sliver and the second a 55-grain sliver.

The roving process was set up to produce 1.25 hank roving using a 1.30 twist-multiplier and a spindle speed of 900 r.p.m. Sliver samples for moisture determinations were taken from the drawing sliver remaining in the slubber creel after processing the necessary roving.

In the spinning process, 40's filling yarn with a 3.75 twist-multiplier and 30's warp yarn with a 4.25 twist-multiplier were spun with a spindle speed of 11,000 r.p.m. from single creel 1.25 hank roving. New travelers were used on each doff, and the frames were allowed to run for 30 minutes before an ends-down count was made. This period served as a break-in period for the travelers, and also produced yarn for sizing so that the correct draft gear could be determined.

A spinning test on each lot consisted of running a full doff. The 40's yarn required 8 1/2 hours per doff of continuous frame operation or 8,568 spindle hours, while the 30's yarn required 7 1/2 hours per doff or 7,560 spindle hours. Ends-down were recorded on 15 minute cycles and these data were combined so that ends-down per 1,000 spindle hours could be determined.

Each lot was processed under controlled conditions of 75° F. and 55-percent relative humidity in both the carding and spinning rooms. The outline of the processing organization is:

Opening equipment:	(Two blender feeders. (One lattice opener. (One number 5 hopper feeder.
Picker:	Two-section, one-process picker.
Carding:	Four standard cards.

Drawing:	Two-process.
Roving:	One slubber 10 X 5, 84 spindles.
Spinning:	(Single creel roving-spun on (Duo-Roth system of drafting. (Four 252 spindle frames.

RESULTS

Moisture Content of Cotton

Before ginning, the average moisture content of three harvestings of seed cotton ranged from 10.4 to 13.2 percent for machine-picked cotton, and that of handpicked lots from 9.8 to 10.5 percent. High and low moisture ginning conditions gave average lint moisture contents of 5.5 to 6.4 percent and 2.4 to 2.7 percent, respectively, for the machine-picked lots, and 6.3 to 3.3 percent, respectively, for the handpicked lots of cotton (table 2).

Moisture content of lint for both machine-picked and handpicked lots of cotton ranged from 5.9 to 3.6 percent when sampled in the opening room of the pilot plant. It was also apparent that the cotton ginned with high moisture content (high-moisture lint) lost an average of 1.2 percent moisture during storage, and those ginned with low moisture content (low-moisture lint) gained an average of 1.7 percent during storage.

Despite the difference in the amount of moisture found at the various stages of ginning, all lots of cotton reached approximately the same moisture content during processing under controlled atmospheric conditions.

Grade and Staple Length

Samples of all bales were classed by a representative from a cotton cooperative, and a representative from the U. S. Department of Agriculture Cotton Classing Office at Greenwood, Miss. The grade of the cotton varied from Low Middling Light Spot to Middling (table 3). In most instances higher grades were obtained by the use of lint cleaners during ginning. In every instance machine-picked cotton subjected to two lint cleaners was graded higher than that with no lint cleaning. Neither seed-cotton cleaning nor lint cleaning appeared to affect the classers' staple length designation (table 3).

The high-moisture lint for machine-picked cotton had a staple length varying from 1 1/16 to 1 3/32 inches while the low-moisture lint had a staple length varying from 1 1/32 to 1 1/16 inches.

The grades of machine-harvested cotton were lower than those of handpicked cotton receiving the same ginning treatments. Classers' staple length showed no consistent difference between the machine-harvested and the handpicked cotton for similar ginning treatments.

Table 2.--Average moisture content of three harvests of machine and hand-picked seed cotton and of lint cotton at various stages of ginning and processing

Ginning conditions	Moisture content (by oven method)					
					Processing	
	Seed-cotton wagon sample	Roller-ginned lint	Lint-slide sample	Lint moisture removed 1/	Opening room	Finishe drawing
	Percent	Percent	Percent	Percent	Percent	Percen
Machine-picked lots:						
Elaborate seed-cotton cleaning:						
High-moisture lint:						
No lint cleaner	12.5	9.8	6.4	35	4.8	5.6
1 lint cleaner 2/	13.0	10.9	6.2	43	4.4	5.9
2 lint cleaners 3/	13.2	10.0	6.0	40	5.9	6.2
Low-moisture lint:						
No lint cleaner	10.4	9.1	2.6	71	4.3	5.7
1 lint cleaner 2/	11.4	8.0	2.5	69	4.6	5.6
2 lint cleaners 3/	10.8	8.2	2.7	67	4.5	5.7
Moderate seed-cotton cleaning:						
High-moisture lint:						
No lint cleaner	12.4	9.7	6.1	37	4.4	5.8
1 lint cleaner 2/	12.0	10.6	6.3	41	3.2	6.0
2 lint cleaners 3/	11.0	8.2	5.5	33	4.7	5.7
Low-moisture lint:						
No lint cleaner	11.2	9.0	2.4	73	4.4	5.7
1 lint cleaner 2/	11.0	8.8	2.5	72	3.6	5.0
2 lint cleaners 3/	12.2	9.5	2.7	72	4.3	5.9
Handpicked lots:						
Elaborate seed-cotton cleaning:						
Low-moisture lint:						
2 lint cleaners 2/, 3/	10.5	7.0	3.3	53	4.9	5.8
Moderate seed-cotton cleaning:						
High-moisture lint:						
No lint cleaner	9.8	7.6	6.3	17	4.7	5.6

1/ Percent of lint moisture removed = $\frac{\text{Roller ginned lint moisture - lint-slide-sample moisture}}{\text{Roller-ginned lint moisture}}$

2/ Unit saw-type cleaner.

3/ Battery-type cleaner.

Table 3.--Grade and staple classification of three harvests of machine and hand-picked seed cotton after different ginning treatment 1/

Harvesting and ginning conditions	First harvesting		Second harvesting		Third harvesting	
	Grade	Staple length	Grade	Staple length	Grade	Staple length
		32nds inch		32nds inch		32nds inch
Machine-picked lots:						
Elaborate seed-cotton cleaning:						
High-moisture lint:						
No lint cleaner	LM	35	LM	34	LM	34
1 lint cleaner 2/	LM+	35	LM	34	LM+	35
2 lint cleaners 3/	SLM	34	LM+	35	SLM	35
Low-moisture lint:						
No lint cleaner	LM+	33	LM+	34	SLM	34
1 lint cleaner 2/	SLM Lt Sp	34	SLM	34	SLM	34
2 lint cleaners 3/	M Lt Sp	34	SLM	34	SLM+	34
Moderate seed-cotton cleaning:						
High-moisture lint:						
No lint cleaner	LM	34	LM+	35	LM+	34
1 lint cleaner 2/	LM	34	LM+	35	LM+	34
2 lint cleaners 3/	SLM	34	SLM	35	SLM	35
Low-moisture lint:						
No lint cleaner	LM Lt Sp	33	LM+	34	LM+	33
1 lint cleaner 2/	SLM Lt Sp	33	LM+	34	SLM	34
2 lint cleaners 3/	SLM	33	SLM+	34	SLM	34
Handpicked lots:						
Elaborate seed-cotton cleaning:						
Low-moisture lint:						
2 lint cleaners 2/, 3/	M	34	M	34	M	36
Moderate seed-cotton cleaning:						
High-moisture lint:						
No lint cleaner	SLM	35	SLM	34	SLM	35

1/ M. Middling; SLM+. Strict Low Middling Plus; SLM. Strict Low Middling; LM+. Low Middling Plus; LM. Low Middling; M Lt Sp. Middling Light Spotted; SLM Lt Sp. Strict Low Middling Light Spotted; LM Lt Sp. Low Middling Light Spotted.

2/ Unit saw-type cleaner.

3/ Battery-type cleaner.

Total Waste Content

Total waste content, as obtained by the Shirley Analyzer for ginned lint and card sliver, are shown in table 4. The addition of lint cleaners had a highly significant effect in reducing the waste content of ginned lint. Drying to a lower moisture level caused a significant reduction in total waste content. None of the other variables or their interactions were found to be statistically significant with respect to total waste content of the ginned lint or of the card sliver.

Fiber Length by Array Method

Drying to a low moisture level caused a significant reduction of mean length and increased the coefficient of length variation of the ginned lint (table 5). For the card sliver, drying to a low moisture level caused a highly significant reduction of the upper quartile length and a significant reduction of mean length, and an increase in the coefficient of length variation and short fiber content.

Additional lint cleaning had a highly significant effect in reducing the upper quartile length and mean length, and increased the coefficient of length variation and short fiber content of the ginned lint. For the card sliver, additional lint cleaning caused an increase in short fiber content and coefficient of length variation.

The average upper quartile length for all lint samples of the high-moisture lint was 1.26 inches, which is 0.02 inch longer than the low-moisture lint. This difference in average upper quartile length for high- and low-moisture lint was also found in the card sliver. The upper quartile lengths for card sliver were 0.04 inch shorter than those for ginned lint samples.

Fiber length decreased when a second lint cleaner was used with low-moisture lint, regardless of the amount of seed cotton cleaning. The short fiber content of the lint, and the coefficient of length variation increased with the use of a second lint cleaner for low-moisture lint.

Fiber Length by Fibrograph Measurement

Fibrograph test data for ginned lint and card sliver samples are shown in table 6. None of the variables or interactions investigated affected, significantly, the measurements made on ginned lint.

Drying to a low moisture level caused a significant reduction in the upper half mean length of the card sliver. The interaction of seed-cotton cleaning and lint moisture significantly affected the uniformity ratio of the card sliver; the greatest difference being shown between the elaborate overhead cleaning for high- and low-moisture lint.

Table 4.--Effect of cotton ginning conditions on total waste content as measured by Shirley Analyzer for ginned lint and card sliver

Machine-picked cotton ginning conditions	Total waste content by Shirley Analyzer	
	Ginned lint	Card sliver
	Percent	Percent
Elaborate seed-cotton cleaning:		
High-moisture lint:		
No lint cleaner	4.70	.98
1 lint cleaner 1/	4.01	.93
2 lint cleaners 2/	2.74	.97
Average	3.81	.96
Low-moisture lint:		
No lint cleaner	3.46	1.01
1 lint cleaner 1/	2.68	.91
2 lint cleaners 2/	1.96	.85
Average	2.70	.92
Moderate seed-cotton cleaning:		
High-moisture lint:		
No lint cleaner	4.71	.94
1 lint cleaner 1/	3.74	.87
2 lint cleaners 2/	2.45	.80
Average	3.63	.87
Low-moisture lint:		
No lint cleaner	3.95	1.07
1 lint cleaner 1/	2.82	1.07
2 lint cleaners 2/	1.96	.97
Average	2.91	1.04
	Analysis of variance 3/	
Lint cleaners	**	NS
Moisture content	*	NS
Coefficient of variation	14.40	12.26

1/ Unit saw-type cleaner.
2/ Battery-type cleaner.
3/ * = significant at 5 percent level; ** = significant at 1 percent level; NS = not significant.

Table 5.--Effect of cotton ginning conditions on fiber length and length distribution, as measured by the fiber array method

Machine-picked cotton ginning conditions	Upper quartile length		Mean length		Coefficient of variation		Short fiber content 1/	
	Ginned lint	Card sliver	Ginned lint	Card sliver	Ginned lint	Card sliver	Ginned lint	Card sliver
	In.	In.	In.	In.	Pct.	Pct.	Pct.	Pct.
Elaborate seed-cotton cleaning:								
High-moisture lint:								
No lint cleaner	1.26	1.23	1.05	.97	30	34	8.5	12.6
1 lint cleaner 2/	1.26	1.23	1.05	.96	30	36	8.6	13.3
2 lint cleaners 3/	1.26	1.22	1.04	.97	30	35	8.9	13.0
Average	1.26	1.23	1.05	.97	30	35	8.7	13.0
Low-moisture lint:								
No lint cleaner	1.25	1.21	1.01	.93	32	38	10.4	15.0
1 lint cleaner 2/	1.24	1.20	1.01	.93	32	38	10.7	15.7
2 lint cleaners 3/	1.23	1.19	.99	.91	34	39	11.5	16.8
Average	1.24	1.20	1.00	.92	33	38	10.9	15.8
Moderate seed-cotton cleaning:								
High-moisture lint:								
No lint cleaner	1.26	1.21	1.04	.95	31	35	9.2	13.0
1 lint cleaner 2/	1.26	1.22	1.05	.97	30	34	8.6	12.2
2 lint cleaners 3/	1.25	1.21	1.02	.95	32	37	10.3	15.0
Average	1.26	1.21	1.04	.96	31	35	9.4	13.4
Low-moisture lint:								
No lint cleaner	1.24	1.20	1.02	.93	32	37	10.3	15.1
1 lint cleaner 2/	1.24	1.20	1.00	.93	33	37	10.8	15.3
2 lint cleaners 3/	1.23	1.19	.98	.91	34	39	12.3	16.5
Average	1.24	1.20	1.00	.92	33	38	11.1	15.6
				Analysis of variance 4/				
Moisture content	*	**	**	**	**	**	*	**
Lint cleaners	***	NS	***	NS	***	**	***	***
Coefficient of variation	.78	1.02	1.36	1.91	3.47	2.76	8.36	7.05

1/ Percentage of fibers shorter than 1/2 inch by the array method.
2/ Unit saw-type cleaner.
3/ Battery-type cleaner.
4/ * = significant at 10 percent level; ** = significant at 5 percent level; *** = significant at 1 percent level; NS = not significant.

Table 6.--Effects of cotton ginning conditions on Fibrograph measurements for ginned lint and card sliver samples

Machine-picked cotton ginning conditions	Upper half mean		Mean length		Uniformity ratio	
	Ginned lint	Card sliver	Ginned lint	Card sliver	Ginned lint	Card sliver
	Inches	Inches	Inches	Inches	Ratio	Ratio
Elaborate seed-cotton cleaning:						
High-moisture lint:						
No lint cleaner	1.11	1.11	.86	.86	78	78
1 lint cleaner 1/	1.11	1.09	.86	.84	77	77
2 lint cleaners 2/	1.11	1.10	.86	.86	78	78
Average	1.11	1.10	.86	.85	78	78
Low-moisture lint:						
No lint cleaner	1.09	1.08	.85	.82	77	75
1 lint cleaner 1/	1.08	1.07	.85	.81	78	75
2 lint cleaners 2/	1.07	1.06	.83	.81	77	76
Average	1.08	1.07	.84	.81	77	75
Moderate seed-cotton cleaning:						
High-moisture lint:						
No lint cleaner	1.10	1.10	.87	.85	79	77
1 lint cleaner 1/	1.11	1.10	.87	.85	79	78
2 lint cleaners 2/	1.10	1.09	.85	.84	77	77
Average	1.10	1.10	.86	.85	78	77
Low-moisture lint:						
No lint cleaner	1.08	1.07	.83	.81	77	76
1 lint cleaner 1/	1.08	1.07	.83	.81	77	76
2 lint cleaners 2/	1.07	1.06	.82	.80	76	76
Average	1.08	1.07	.83	.81	77	76
			Analysis of variance 3/			
Moisture content	NS	*	NS	NS	NS	NS
Seed-cotton cleaning X moisture content	NS	NS	NS	NS	NS	*
Coefficient of variation	1.11	1.10	2.05	2.07	1.24	1.41

1/ Unit saw-type cleaner.
2/ Battery-type cleaner.
3/ * = significant at 5 percent level; NS = not significant.

Fiber Strength by Pressley Method

Strength of the ginned lint as determined by the "0" gauge Pressley test, indicated that none of the variables or interactions tested in the analysis of variance had a significant effect on fiber strength (table 7). Similar measurements made on card sliver indicated that drying to a low moisture level and also the use of lint cleaners had significant effects in reducing the fiber strength.

Strength measurements as determined by the 1/8-inch gauge Pressley strength test indicated that none of the variables or interactions as tested in the analysis of variance had significant effects on either the ginned lint or the card sliver. Both "0" gauge and 1/8-inch gauge Pressley tests showed stronger fiber strength in the card sliver than in the ginned lint.

Picker and Card Waste

Drying to a low moisture level caused a highly significant decrease in the total picker and card waste (table 8). The use of lint cleaners also caused a significant decrease in the total picker and card waste. The interaction of moisture and lint cleaners had a significant effect upon the amount of processing waste removed, the greatest reduction being obtained when lint cleaners were used with the low-moisture lint.

Ends-Down per Thousand Spindle Hours for 40's Yarn

Moisture content at time of ginning had a significant effect on ends-down per thousand spindle hours for the 40's filling yarn (table 8). The average ends-down of high-moisture lint varied from 66 for elaborate seed-cotton cleaning to 52 when moderate seed-cotton cleaning equipment was used. On the average, low-moisture lint produced 25 fewer ends-down than did the high-moisture lint. The effect of seed-cotton cleaning on ends-down for the low-moisture lint was negligible.

Usually, cotton ginned with a very low lint-moisture content produces a greater number of ends-down per thousand spindle hours than cotton ginned with a high lint-moisture content. In this study the trend reversed; this unexplained trend is being further investigated.

Break Factor for 40's Yarn

Moisture at time of ginning and lint cleaning had a significant effect on the break factor of 40's yarn. The interaction of lint cleaners times moisture, and lint cleaners times moisture times seed-cotton cleaning had highly significant effects; and the interaction of lint cleaners times seed-cotton cleaning had a significant effect on the break factor of 40's yarn (table 8). High-moisture lint ginned with elaborate seed-cotton cleaning and two lint

Table 7.--Effects of cotton ginning conditions on Pressley strength measurements and Causticaire fineness and maturity determinations for ginned lint and card sliver

Machine-picked cotton ginning conditions	Pressley strength				Causticaire			
	"0" Gauge		1/8" Gauge (str. wt.)		Maturity		Fineness	
	Ginned lint	Card sliver	Ginned lint	Card sliver	Ginned lint	Card sliver	Ginned lint	Card sliver
	1,000 p.s.i.	1,000 p.s.i.	Ratio	Ratio	Index	Index	µg./in.	µg./in.
Elaborate seed-cotton cleaning:								
High-moisture lint:								
No lint cleaner	76	77	3.09	3.19	73	78	4.2	4.0
1 lint cleaner 1/	77	78	3.13	3.28	74	78	4.2	3.9
2 lint cleaners 2/	77	77	3.15	3.20	73	78	4.1	4.0
Average	77	77	3.12	3.22	73	78	4.2	4.0
Low-moisture lint:								
No lint cleaner	75	76	3.02	3.24	74	79	4.2	4.0
1 lint cleaner 1/	75	76	3.03	3.16	74	79	4.1	4.0
2 lint cleaners 2/	74	75	3.01	3.12	74	79	4.2	4.1
Average	75	76	3.02	3.17	74	79	4.2	4.0
Moderate seed-cotton cleaning:								
High-moisture lint:								
No lint cleaner	76	77	3.11	3.16	74	78	4.2	4.0
1 lint cleaner 1/	76	77	3.13	3.20	74	78	4.1	4.0
2 lint cleaners 2/	77	76	3.12	3.14	74	79	4.1	4.0
Average	76	77	3.12	3.17	74	78	4.1	4.0
Low-moisture lint:								
No lint cleaner	74	77	2.98	3.24	75	78	4.2	4.0
1 lint cleaner 1/	75	77	2.96	3.22	74	78	4.3	4.0
2 lint cleaners 2/	75	75	2.99	3.14	74	78	4.3	4.0
Average	75	76	2.98	3.20	74	78	4.3	4.0
			Analysis of variance 3/					
Moisture content	NS	**	NS	NS	NS	NS	-	-
Lint cleaners	NS	*	NS	NS	NS	NS	-	-
Coefficient of variation	2.19	1.27	2.24	2.32	1.59	1.12	-	-

1/ Unit saw-type cleaner.

2/ Battery-type cleaner.

3/ * = significant at 5 percent level; ** = significant at 1 percent level; NS = not significant.

Table 8.--Processing performance of machine-picked cotton for 40's yarn, as affected by ginning conditions

Ginning conditions	Ends-down per 1,000 spindle hrs.	Yarn break factor	Yarn appearance 1/	Neps per 100 sq.in. card web	Picker and card waste 2/
	Number	Lb.xNo.	Index	Number	Percent
Elaborate seed-cotton cleaning:					
High-moisture lint:					
No lint cleaner	64	1984	93	9	7.92
1 lint cleaner 3/	71	2083	87	9	7.56
2 lint cleaners 4/	64	2121	90	10	6.14
Average	66	2063	90	9	7.21
Low-moisture lint:					
No lint cleaner	36	1913	90	9	7.23
1 lint cleaner 3/	30	1877	90	9	6.00
2 lint cleaners 4/	36	1824	87	15	5.87
Average	34	1871	89	11	6.37
Moderate seed-cotton cleaning:					
High-moisture lint:					
No lint cleaner	52	2037	100	9	7.95
1 lint cleaner 3/	56	2060	90	9	7.31
2 lint cleaners 4/	47	1975	83	10	6.02
Average	52	2024	91	9	7.09
Low-moisture lint:					
No lint cleaner	33	1879	90	8	7.54
1 lint cleaner 3/	40	1899	87	9	6.61
2 lint cleaners 4/	31	1837	87	9	5.37
Average	35	1872	88	9	6.51
			Analysis of variance 5/		
Moisture content	*	*	NS	NS	**
Seed cotton cleaning X moisture	NS	NS	NS	*	NS
Lint cleaner	NS	*	**	**	**
Lint cleaner X moisture	NS	**	NS	*	*
Lint cleaner X seed cotton cleaning	NS	*	NS	**	NS
Lint cleaner X moisture X seed cotton cleaning	NS	**	NS	*	NS
Coefficient of variation	19.06	2.59	4.53	10.91	5.55

1/ Based on USDA grade index. 100 = average; 90 = fair; 80 = poor; 70 = very poor.

2/ Total adjusted picker and card waste.

3/ Unit saw-type cleaner.

4/ Battery-type cleaner.

5/ * = significant at 5 percent level; ** = significant at 1 percent level; NS = not significant.

cleaners, is associated with the highest yarn break factor. Break factor increased as the amount of lint cleaning was increased. Yarn break factor values for the low-moisture lint ginned with elaborate seed-cotton cleaning were the reverse of these trends. For both the high- and low-moisture lint ginned with moderate seed-cotton cleaning the highest and lowest break factors were associated with one lint cleaner and two lint cleaners, respectively.

Appearance Index for 40's Yarn

The use of lint cleaners had a significant effect in reducing the yarn appearance grade for 40's yarn (table 8). The highest yarn appearance index was produced by high-moisture lint ginned with moderate seed-cotton cleaning and no lint cleaning. In every case, cottons ginned with two lint cleaners had a lower yarn appearance index than cotton ginned with no lint cleaning for their respective ginning treatments.

Neps Per 100 Square Inches of Card Web

The effect of lint cleaners on the number of neps per 100 square inches of card web was highly significant (table 8). The amount of seed-cotton cleaning had no effect on nep content of the high-moisture lint. Low-moisture lint ginned with elaborate seed-cotton cleaning equipment produced 9 neps when no lint cleaning was used and 15 neps when two lint cleaners were used. These differences in neps are not of practical significance because of the very low number of neps per 100 square inches of card web.

Ends-Down, Yarn Break Factor, and Yarn Appearance of 30's Yarn

No variance analyses were made of the processing data from the 30's warp yarn because the yarn was spun from a composite of three replications of card sliver blended at the drawing process.

The results of the ends-down per 1,000 spindle hours, yarn break factor, and yarn appearance tests are shown in table 9. The same trend was shown for ends-down and yarn break factor for 30's yarn as was obtained for 40's yarn. The 30's yarn spun from the low-moisture lint produced the same average number of ends-down for both the elaborate and moderate seed-cotton cleaning treatments, but the ends-down count decreased for cotton passed through the second lint cleaner. The 30's yarn spun from high-moisture lint had an average of 22 ends-down for elaborate seed-cotton cleaning and 19 ends-down for moderate seed-cotton cleaning. The number of ends-down was higher for yarn from cotton ginned with one lint cleaner as compared to that ginned with two lint cleaners.

Lower yarn break factors resulted from low-moisture lint than from high-moisture lint. The average yarn break factor was higher for the elaborate seed-cotton cleaning than for the moderate seed-cotton cleaning for their respective moisture levels. In general, break factor decreased with an increase in lint cleaning; however, a reversal in this trend occurred in the case of high-moisture lint ginned with elaborate seed-cotton cleaning.

Table 9.--Processing performance of machine-picked cotton for 30's yarn as affected by ginning conditions

Ginning conditions	Ends-down per 1,000 spindle hours	Yarn break factor	Yarn appearance grade
	Number	Lb.xNo.	
Elaborate seed-cotton cleaning:			
High-moisture lint:			
No lint cleaner	20	2265	C+
1 lint cleaner 1/	24	2277	C+
2 lint cleaners 2/	23	2340	C+
Average	22	2294	C+
Low-moisture lint:			
No lint cleaner	17	2136	C+
1 lint cleaner 1/	11	2124	C
2 lint cleaners 2/	11	2088	C
Average	13	2116	C
Moderate seed-cotton cleaning:			
High-moisture lint:			
No lint cleaner	20	2286	C
1 lint cleaner 1/	22	2268	C+
2 lint cleaners 2/	16	2139	C
Average	19	2231	C
Low-moisture lint:			
No lint cleaner	14	2097	C+
1 lint cleaner 1/	13	2058	C+
2 lint cleaners 2/	11	2079	C+
Average	13	2078	C+

1/ Unit saw-type cleaner.
2/ Battery-type cleaner.

Lint cleaners had no apparent effect on appearance of 30's yarn. Yarn grades of C+ were produced with elaborate seed-cotton cleaning high-moisture lint and with moderate seed-cotton cleaning low-moisture lint. Yarn grades of C were usually produced with elaborate seed-cotton cleaning low-moisture lint and with moderate seed-cotton cleaning high-moisture lint. That is, either seed-cotton cleaning or drying made some improvement in yarn appearance but together they did not.

Comparison of Hand-Picked and Machine-Picked Cotton

A comparison of the hand-picked and machine-picked cotton ginned under similar conditions is shown in table 10. For like ginning treatments, the handpicked cotton gave better results than machine-picked cotton in grades and staple length, and in all fiber properties except percent of short fibers. Also, the handpicked cotton gave better results in break factor for 30's and 40's yarns, lower nep count, ends-down, and a better yarn appearance.

Handpicked cotton, compared with machine-picked cotton, required less heating to reduce moisture content for each similar ginning condition.

EFFECT OF DRYING AND CLEANING ON BALE WEIGHTS AND NET BALE VALUES

Current practices of drying and cleaning mechanically-harvested cotton at the gin usually improve the grade of a bale of cotton and cause reduction in bale weight because of loss of moisture and trash during ginning. In some instances, the improvement in grade and the associated price increase of the cotton is sufficient to offset the loss of bale weight. To determine if price per bale is increased or decreased by ginning practices it is necessary to consider weight losses, grade improvements, and premiums and discounts. Such evaluation does not include an analysis of the effect of any ginning practice on the spinnability of cotton, as only the immediate short-term implications of cash returns to producers are involved in this particular situation.

An evaluation of the effect of drying and cleaning on bale weights and net bale values for the 36 bales of machine-picked cotton used in the ginning-spinning study is given in table 11. Because of the physical set-up of the gin, it was not possible to separate and weigh the foreign matter and lint actually extracted from each lot by each lint cleaner. Hence, it was necessary to estimate weight losses from differences in the amount of foreign matter remaining in the ginned lint, as shown by the Shirley Analyzer. This underestimates the loss to the producer because the lint cleaner usually takes out 3 to 5 pounds of lint along with the trash. Thus, actual bale values would have averaged approximately 1 dollar less than those shown in table 11 for one lint cleaner and more than a dollar less for the double-lint cleaned lots. The base price for Middling-inch cotton in November 1960 was used in all calculations. For 1958 prices, the premiums and discounts for November of that year were applied to the 1960 base price, and 1960 prices were determined by applying November 1960 premiums and discounts to the base price for that year.

Table 10.--Fiber and processing data for handpicked and machine-picked cotton for two ginning conditions

Text identification	Ginning conditions			
	Elaborate seed cotton cleaning: Low-moisture lint: 2 lint cleaners:		Moderate seed cotton cleaning: High-moisture lint: No lint cleaner:	
	Hand-picked 1/	Machine-picked 1/	Hand-picked 1/	Machine-picked 1/
FIBER DATA				
Suter-Webb Array:				
U. Q. length (inches)	1.22	1.23	1.26	1.26
Mean length (inches)	.97	.99	1.04	1.04
Coef. of variation (percent)	34	34	30	31
Short fiber content 2/ (percent)	12.6	11.5	9.1	9.2
Fibrograph:				
Upper half mean (inches)	1.06	1.07	1.11	1.10
Mean length (inches)	.81	.83	.87	.87
Uniformity ratio (ratio)	76	77	79	79
Pressley Strength:				
"0" gauge (1,000 p.s.i.)	78	74	77	76
1/8" gauge (ratio)	3.05	3.01	3.10	3.11
Micronaire:				
Fineness (reading)	3.8	3.9	3.9	3.8
PROCESSING DATA				
Neps (per 100 sq. inches of card web)	15	15	6	9
Picker and card waste (percent)	5.31	5.87	6.46	7.95
Ends-down (per 1,000 spindle hrs.)				
30's yarn	8	11	8	20
40's yarn	26	36	26	52
Yarn break factor (ratio)				
30's yarn	2073	2088	2247	2286
40's yarn	1859	1824	2051	2037
Yarn appearance (grade)				
30's yarn	C	C	C+	C
40's yarn	C-	C-	C	C+

1/ Figures shown are the average for the 3 replications.
2/ Percentage of fibers shorter than 1/2 inch by the array method.

Table 11.--Average value of cotton as affected by ginning conditions for machine-picked cotton

Ginning conditions	First harvesting		Second harvesting		Third harvesting		Average bale value 1/	
	Weight per bale	Price per lb.	Weight per bale	Price per lb.	Weight per bale	Price per lb.	1958	1960
	Pounds 2/	Cents 3/	Pounds 2/	Cents 3/	Pounds 2/	Cents 3/	Dollars	Dollars
Elaborate seed-cotton cleaning:								
High-moisture lint:								
No lint cleaner	491.0	25.18	492.7	24.93	497.5	24.93	123.50	137.42
1 lint cleaner 4/	490.5	27.48	490.0	24.93	488.0	27.48	130.35	139.23
2 lint cleaners 5/	483.5	29.27	485.5	27.48	486.0	29.77	139.87	141.65
Low-moisture lint:								
No lint cleaner	471.9	26.60	472.8	27.10	470.9	29.27	130.50	134.76
1 lint cleaner 4/	467.1	25.85	468.5	29.27	464.2	29.27	131.25	134.27
2 lint cleaners 5/	468.5	28.31	465.1	29.27	464.6	30.78	139.31	137.38
Moderate seed-cotton cleaning:								
High-moisture lint:								
No lint cleaner	500.0	24.93	493.5	27.48	491.0	27.10	131.10	139.96
1 lint cleaner 4/	495.5	24.93	492.0	27.48	490.5	27.10	130.55	139.33
2 lint cleaners 5/	480.1	29.27	480.6	29.77	481.1	29.77	142.27	141.57
Low-moisture lint:								
No ling cleaner	475.2	20.50	466.6	27.10	469.0	26.60	116.20	127.13
1 lint cleaner 4/	470.5	25.92	468.5	27.10	467.1	29.27	128.54	132.96
2 lint cleaners 5/	465.5	28.52	465.1	30.78	465.1	29.27	137.35	136.31

1/ Average value of 3 replications. 1958 values are bale weights times prices per pound in this table. 1960 values, bale weights times 1960 prices.

2/ Bale weight adjusted to account for foreign matter differences as determined by Shirley Analyzer, and differences in lint moisture. Actual weight loss at gins usually greater than shown by Shirley Analyzer test because of loss of fiber in gin lint cleaning.

3/ Based on grades and staple lengths obtained in this study as shown in table 3. November, 1958 premiums and discounts applied to November, 1960 price for Middling 1-inch cotton. Price quotations, Greenwood, Mississippi. Cotton Price Statistics XL (4) Nov., 1958 and XLII (4) Nov., 1960.

4/ Unit saw-type cleaner.

5/ Battery-type cleaner.

Therefore, the bale values shown reflect only changes in premiums and discounts for the 2 years with a constant base price.

Table 11 shows, that for this particular lot of 36 bales of cotton, the use of 2 lint cleaners, compared with no lint cleaning, improved net bale values to the producer. Also, the use of the second lint cleaner generally added more value than use of the first lint cleaner. This result is ascribable to the heavy cleaning and waste removal action of the first lint cleaner, followed by the finishing-cleaning action of the second lint cleaner with removal of smaller waste-particles, thereby producing a relatively substantial improvement in the grade value.

Drying the cotton to a low level of lint moisture (1.6 percent to 3.2 percent) with either the elaborate or moderate seed-cotton cleaning treatment during ginning resulted in a net loss in bale value to the producer, ranging from approximately $3 to more than $10 per bale. Drying the cotton to a high level of lint moisture (4.8 percent to 7.4 percent) combined with moderate seed-cotton cleaning and 2 lint cleaning treatments, produced net bale values much higher than those of bales ginned with an elaborate seed-cotton cleaning treatment and 2 lint cleaners.

To the extent that ginning charges reflect increased cost of providing any of the services associated with bale-value improvement, either attempted or real, the net loss to the producer would be somewhat greater. There was no feasible way to determine increased costs to the producer because area ginning charges per bale are generally standard, regardless of the diversified service rendered.

Generally, there was a significant reduction in the discounts for lower grades in 1960, compared with 1958. Specifically, the difference between Low Middling and Strict Low Middling, 1 1/16 inch cotton in 1958 amounted to 435 points ($21.75 per 500-pound bale) compared to only 155 points ($7.75) in 1960. Usually such reduction was the result of increased market value for the lower grade, and was not due to a reduction in values for the higher grades. As differences between grades become narrower, losses in weight associated with gin practices of drying and cleaning will result in greater loss in net bale value to the producer.

COTTON COSTS TO MILLS VERSUS YARN QUALITY

In order to compare cotton costs per pound of yarn or fabric produced, raw cotton prices must be adjusted for differences in percentages of manufacturing waste. In the 36 lots of machine-picked cotton processed into yarn, total picker and card waste per bale varied from 5.3 percent to nearly 9 percent. Adding 4.4 percent of the bale weight for bagging and ties to the percentage of picker and card waste per bale gives the total waste percentages on which estimates of clean cotton costs were based. Thus, these estimates substantially represent the cost of raw cotton per pound of card sliver produced.

Mills' waste losses are offset to some extent by revenue from the sale of waste. Since there are no quality standards for cotton waste, and no way of determining waste prices except by submitting actual samples to waste dealers, waste revenues have been omitted from this study. However, if the average mill makes about 5-percent waste at processes after carding, and if the average waste revenue is somewhere near 5 percent of the amount spent for cotton, these two omissions almost cancel each other and these clean cotton costs are not too far from what they would have been if it had been possible to obtain more complete data. Since low grades produce more waste than high grades, there is less difference between grades in clean cotton costs than in raw cotton prices. However, in most recent years, the price differentials have been larger than the differences in waste percentages, so that low grades are usually cheaper than high grades, even after allowance for waste.

For this study, November 1958 and November 1960 premiums and discounts for grade and staple length at Greenwood, Miss., were applied to the November 1960 price of Middling-inch cotton at Greenwood, in order to eliminate the difference in average price levels between the two years.

Coefficients of rank correlation were calculated between all possible pairs of 1958 and 1960 raw cotton prices and 1958 and 1960 clean cotton costs, and all were between .89 and .99. Price differences between grades were less in 1960 than in 1958, and less in clean cotton costs than in raw cotton prices. Prices for 1958 show coefficients of rank correlation of .93 with 1960 prices, .99 with 1958 clean cotton costs and .975 with 1960 clean cotton costs. To avoid confusion, most of the discussion that follows will refer to 1958 raw cotton prices. Differences in the other prices studied follow similar trends.

The data are summarized in two tables. Table 12 gives averages for the three replications, grouped by ginning treatments. Table 12 also shows average differences in break factor, yarn appearance index, manufacturing waste, price, and clean cotton cost due to differences in treatment. In general, any additional cleaning or drying at the gin resulted in lower yarn strength, poorer appearance, higher prices, and less waste, but not enough less to offset the difference in price, so that clean cotton costs were higher as the result of extra cleaning or drying. Table 13 lists individual lots in descending order of break factor for 40's yarn.

Price and Yarn Strength

There appears to be little or no correlation between price and yarn strength. However, it is interesting to note in table 13 that of the two highest-priced bales (those classed Strict Low Middling Plus, 1 1/16", price 30.78 cents per pound in 1958), one was among the three lowest in yarn strength with a break factor of 1772, and the other was well below average strength with a break factor of 1848. The lowest-price bale (Low Middling Light Spot, 1 1/32") had a break factor of 1836. The average price of the seven lots with break factors of 2100 and higher was 27.39 cents in 1958, while the three with break factors below 1800 averaged 29.20, a premium of 181 points for an 18 percent reduction in yarn strength. By December 1961 prices (14-market average), this difference is reduced to 121 points, and at

Table 12.--Effect of gin cleaning and drying on break factor, yarn appearance index and prices, machine-picked cotton

Ginning conditions	Break factor	Appearance	Raw cotton price		Manufacturing waste	Clean cotton cost	
			1958	1960	(percent)	1958	1960
Elaborate seed-cotton cleaning:							
High-moisture lint:							
No lint cleaner	1934	93	25.01	27.63	12.32	28.53	31.74
1 lint cleaner 1/	2083	87	26.63	28.44	11.96	30.25	32.31
2 lint cleaners 2/	2121	90	28.84	29.21	10.54	32.24	32.65
Average	2063	90	26.83	28.49	11.61	30.34	32.23
Low-moisture lint:							
No lint cleaner	1913	90	27.66	28.56	11.63	31.29	32.32
1 lint cleaner 1/	1877	90	28.13	28.78	10.40	31.69	32.12
2 lint cleaners 2/	1824	87	29.45	29.48	10.27	32.63	32.85
Average	1871	89	28.41	28.94	10.77	31.94	32.43
Moderate seed-cotton cleaning:							
High-moisture lint:							
No lint cleaner	2037	100	26.50	28.29	12.35	30.23	32.27
1 lint cleaner 1/	2060	90	26.50	28.29	11.71	30.01	32.04
2 lint cleaners 2/	1975	83	29.60	29.46	10.42	33.05	32.88
Average	2024	91	27.53	28.68	11.49	31.10	32.40
Low-moisture lint:							
No lint cleaner	1879	90	24.73	27.47	11.94	28.07	30.71
1 lint cleaner 1/	1899	87	27.43	28.37	11.01	30.82	31.88
2 lint cleaners 2/	1837	87	29.52	29.30	9.77	32.73	32.48
Average	1872	88	27.23	28.38	10.91	30.54	31.69

1/ Unit saw-type cleaner.
2/ Battery-type cleaner.

Table 13.--Effect of ginning conditions on machine-picked cotton, listed in order of yarn break factors

BF 1/	OH 2/	Mois. 3/	Mois. 4/	LC 5/	YAI 6/	Waste 7/	Grade	Staple length	1958 Price 8/
2184	E	H	6.9	2	90	10.84	SLM	35	29.77
2148	E	H	5.8	1	90	11.77	LM	34	24.93
2144	M	H	7.0	0	100	12.37	LM+	35	27.48
2144	M	H	5.9	1	90	11.33	LM+	35	27.48
2136	E	H	6.1	2	90	10.63	LM+	35	27.48
2132	M	H	6.1	1	90	11.48	LM+	34	27.10
2128	E	H	7.2	1	90	12.03	LM+	35	27.48
2080	M	H	5.7	2	90	10.52	SLM	35	29.77
2060	M	H	5.1	0	100	11.35	LM+	34	27.10
2052	E	H	6.9	0	90	12.32	LM	34	24.93
2044	E	H	4.9	2	90	10.15	SLM	34	29.27
2036	E	H	7.4	0	100	12.59	LM	34	24.93
2024	M	H	6.0	2	80	10.13	SLM	35	29.77
1972	E	H	5.5	1	80	12.09	LM+	35	27.48
1960	E	L	2.8	1	90	10.37	SLM	34	29.27
1956	E	L	3.0	0	90	11.85	LM+	34	27.10
1944	M	L	2.4	1	90	10.74	LM+	34	27.10
1940	M	L	2.3	0	90	11.85	LM+	34	27.10
1928	E	L	3.0	2	90	10.34	SLM	34	29.27
1916	M	L	3.1	1	80	10.74	SLM	34	29.27
1916	M	L	3.2	2	90	9.61	SLM	34	29.27
1908	M	H	6.3	0	100	13.33	LM	34	24.93
1904	M	H	7.0	1	90	12.33	LM	34	24.93
1900	E	L	2.1	0	90	11.85	LM+	33	26.60
1884	E	L	2.6	0	90	11.20	SLM	34	29.27
1864	E	H	4.8	0	90	12.04	LM	35	25.18
1860	M	L	2.7	0	90	11.48	LM+	33	26.60
1860	E	L	3.0	1	90	10.19	SLM	34	29.27
1848	M	L	3.1	2	80	9.70	SLM+	34	30.78
1836	M	L	2.3	0	90	12.50	LMLS	33	20.50
1836	M	L	2.1	1	90	11.54	SLMLS	33	25.92
1820	M	H	4.9	2	80	10.62	SLM	34	29.27
1812	E	L	1.6	1	90	10.65	SLMLS	34	25.85
1772	E	L	3.1	2	90	10.15	SLM+	34	30.78
1772	E	L	1.9	2	80	10.33	MLS	34	28.31
1748	M	L	1.7	2	90	9.99	SLM	33	28.52

1/ BF = yarn break factor, 40's yarn.

2/ OH = seed-cotton cleaning condition, or "overhead" cleaning gin equipment; E = elaborate processing; M = moderate processing.

3/ Mois. (rank): H = high moisture content lint; L = low moisture content lint.

4/ Mois. (percent) = moisture content of gin lint slide sample.

5/ LC = number of lint cleaners.

6/ YAI = yarn appearance index, 40's yarn.

7/ Waste (percent) = manufacturing waste.

8/ 1958 price = cotton market quoted price, cents per pound, for grade and staple length.

Greenwood, Miss., it is only 15 points so that the average clean cotton cost for the weaker yarn is 40 points, or about one percent, less than for the strong yarn. This suggest that buyers of spot cotton are becoming aware of possible fiber quality deficiencies in "artificially produced" high-grade cotton. However, even at December 1961 differentials, the over-machined cotton produced for this study would be overpriced. Not many mills would take a 1-percent saving on cotton costs if they knew it meant an 11-pound reduction in the skein strength of 40's yarn, 14 pounds in 30's, and 20 pounds in 20's.

Grade, Staple Length, and Yarn Strength

Average break factor for 1 1/32" cotton was 1836, for 1 1/16" it was 1937, and for 1 3/32" it was 2073, an average difference of 118 units per 32nd. After adjusting all break factors to 1 1/16" by adding 118 to the break factors for 1 1/32" bales and subtracting the same amount for 1 3/32", the average break factors for the white grades are:

Strict Low Middling Plus	1772
Strict Low Middling	1927
Low Middling Plus	1985
Low Middling	1962

Higher strength is associated with lower grade, and the regression line has a slope of 77 units per full grade. In the light-spotted grades, the slope is 91 units per grade. It is not generally believed that overheating or overdrying affects the color of cotton, but of eighteen bales dried to between 1.6 and 3.2 percent moisture, four were classed light-spotted, and no light-spotted bales were produced at higher moisture levels (4.8 percent to 7.4 percent). These four light-spotted bales all came from the first harvesting of machine-picked cotton, about the middle of October. It is possible that additional cleaning of the cotton changed the relationship between leaf and color for these bales, thus resulting in an averaged grade factor classification as light-spotted.

Grade and Yarn Appearance

Of the four bales with yarn appearance indexes of 100, two were graded Low Middling and two, Low Middling Plus. The six bales with yarn appearance indexes of 80 included one Strict Low Middling Plus, three Strict Low Middling, one Low Middling Plus and one Middling Light Spot. Since low grades made the best yarn appearance and high grades the poorest, there is a negative correlation between yarn appearance index and price. Bales producing yarn with an appearance index of 80 averaged approximately three cents per pound higher in 1958 than those with an appearance index of 100. By 1960 price differentials, this difference is reduced to 1.19 cents in raw cotton price and .68 cent in clean cotton cost.

These findings on the relation of grade to yarn strength and appearance differ from those of other studies which have shown that between early and late-harvested cotton, or between different sections of the Cotton Belt, high grade is usually associated with high yarn strength and yarn appearance index. The reason seems to be that between early and late harvesting, or between locations, with average ginning, high grade is associated with growing conditions favorable to fiber strength and maturity and so with better yarn strength and appearance. However, within a given producing area, with the same soil and weather conditions, and the same or similar cotton varieties, the effort to produce high grades by drying and cleaning is accompanied by serious fiber damage. This is true whether the different grades are produced by changes in the operation of one gin, as was done in this test, or by a number of neighboring gins, differently equipped and differently operated, producing different grades from seed cotton of equal quality. The best the ginner can do is to preserve the fiber properties that are present in the seed cotton.

In Table 13, where individual replications are listed in order from highest to lowest break factor, it is seen that Elaborate and Moderate Overhead are mixed almost at random from top to botton of the table, as are no-, one-, and two-lint cleaners. Most of the Low Middling and Low Middling Plus samples are in the upper half of the table and the majority of Strict Low Middling and Strict Low Middling Plus are in the lower half. The top 14 lots were ginned at high moisture, and these include three of the four that made Yarn Appearance Indexes of 100, while four of the six 80-index lots are in the lower half. In actual percent moisture, the trend is even more striking than when they are called merely "high" or "low". Three of the four lots with lowest break factor contained less than two percent moisture. All priced above 30 cents were among the eight that made the weakest yarn, with break factors of 1848 or less; and they were ginned with 3.1 percent moisture or less.

The only two "high" moisture samples in the bottom third of the table contained 4.8 and 4.9 percent moisture, while the top eight contained 5.7 to 7.2 percent.

Of the four Light-Spotted bales, the Low Middling Light Spot had the highest break factor, and the Middling Light Spot the lowest break factor and yarn appearance index.

From the results of this study, it is concluded that the system of price differentials that existed in 1958 and 1960 reflected poorly the true value of different grades to the textile manufacturer. When color change due to weather was not a factor, the narrowing of premiums and discounts since 1960 may indicate that mill buyers are beginning to realize this.

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